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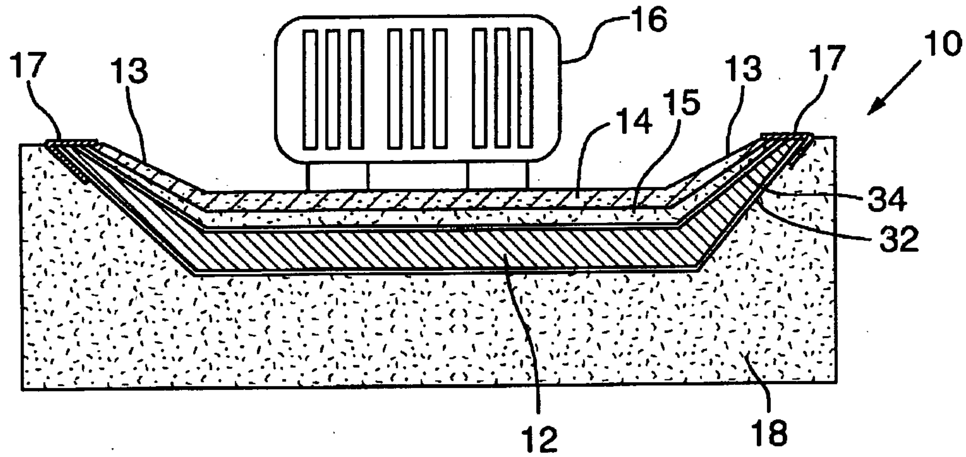
(54) **SYSTEME DE RETENUE DE PETROLE DEVERSE ACCIDENTELLEMENT**

(54) **OIL SPILL CONTAINMENT SYSTEM**



(57) A system is disclosed for temporarily retaining oil spilled from oil containing equipment. The system is essentially a subterranean layer of oil absorbing material positioned below the oil containing equipment. The oil absorbing layer contains a sufficient quantity of oil absorbing material to temporarily retain the oil spilled from the equipment. The oil absorbing material forming the oil absorbing layer is preferably a hydrophobic material which is water permeable.

ABSTRACT

A system is disclosed for temporarily retaining oil spilled from oil containing equipment. The system is essentially a subterranean layer of oil absorbing material positioned below the oil containing equipment. The oil absorbing layer contains a sufficient quantity of oil absorbing material to temporarily retain the oil spilled from the equipment. The oil absorbing material forming the oil absorbing layer is preferably a hydrophobic material which is water permeable.

OIL SPILL CONTAINMENT SYSTEM

FIELD OF THE INVENTION

The present invention relates to a method and apparatus for temporarily containing oil spills from transformers, capacitors, storage tanks and other stationary oil containing facilities.

BACKGROUND OF THE INVENTION

Power transformers, capacitors and related power switch equipment are extensively used by electric utilities as an integral part of the transmission and distribution grid. Due to the size of the electric power transmission and distribution grid, there are literally hundreds of thousands of power transformers in common use throughout North America. A majority of these power transformers contain a large quantity of oil, which is necessary for their function. While power transformers, capacitors and related switching equipment are designed to meet rigorous safety standards, failures occasionally occur which result in the spillage of oil. Due to the size of many power transformers, a serious failure may result in the spilling of hundreds of liters of oil. An oil spill of such a magnitude may result in ground water contamination as the spilled oil tends to pass through the soil beneath the transformers and into the water table. Since power transformers, capacitors and related switching equipment tend to be clustered together, there is a real threat of ground water contamination resulting from equipment failures.

At present, the only practical method of dealing with the threat of ground water contamination from power equipment failure is to place the power equipment in a concrete oil retaining structure. Essentially, before the power equipment is installed, a trench is excavated. Concrete is used to construct a rigid, oil impervious liner for the trench. The power equipment is then erected within the concrete lined trench. If the equipment should leak, then the concrete lining contains the leaked oil, preventing it from entering the soil.

While concrete lined trenches have proven effective in containing oil spills, they have several drawbacks. Firstly, concrete structures of the size required to contain a potential oil spill are time consuming and expensive to construct. Furthermore, large concrete structures tend to disrupt the natural drainage of the site where they are erected. Finally, the problems associated with the build up of rain water and debris must be contended with.

The high cost of erecting concrete oil containing structures prevents their widespread use. As a result, literally thousands of power transformers, capacitors, and related power switching equipment installations, as well as countless other oil storage facilities, are presently without any form of oil spill containment mechanism. The potential for ground water pollution resulting from oil spilling from these unprotected installations is real. There is a serious need for a cost effective mechanism for preventing ground water contamination resulting from stationary oil spills.

SUMMARY OF THE INVENTION

The present invention is directed at a system for temporarily retaining oil spilled from oil containing equipment, the system comprising a subterranean layer of oil absorbing material positioned below the oil containing equipment, said layer containing sufficient oil absorbing material to temporarily retain the oil spilled from the equipment.

The present invention is also directed at a system for temporarily retaining oil spilled from oil containing equipment, the system comprising a layer of water permeable oil absorbing material positioned below the oil containing equipment. The oil absorbing material is contained within a water and oil permeable retaining structure configured to hold the oil absorbing material in place.

The present invention is further directed at a system for temporarily retaining oil spilled from oil containing equipment, the system comprising a layer of water permeable oil absorbing material positioned below the oil containing equipment and a means for draining excess water from the oil absorbing layer. The oil absorbing material is contained within a water and oil permeable retaining structure configured to hold the oil absorbing material in place.

BRIEF DESCRIPTION OF THE FIGURES

Further features and advantages of the method and device embodying the present invention will now be described and made clearer from the ensuing description, reference being had to the accompanying drawings, in which:

FIGURE 1 is a side view of the present invention, partly in cross section, showing the invention;

FIGURE 2 is a perspective view of the retaining structure of the present invention;

FIGURE 3 is a perspective view of the present invention partly in cross section;

FIGURE 4 is a side view of an alternative embodiment of the present invention, partly in cross section; and

FIGURE 5 is a side view of another alternative embodiment of the present invention, partly in cross section.

DETAILED DESCRIPTION OF THE INVENTION

It has been discovered that a subterranean layer of oil absorbing material positioned on top of the soil and below a power transformer can temporarily prevent oil spilled from the transformer from penetrating into the soil. The oil absorbing layer is buried a few inches below the surface to prevent the oil absorbing material from being washed away as a result of rain, wind or spring run off. To be effective, the oil absorbing material must form a layer sufficiently wide and sufficiently thick to retain substantially all of the oil spilled from the transformer. When a failure occurs in the transformer or other oil containing equipment positioned directly above the oil absorbing layer, spilled oil passes through the ground to the oil absorbing layer. The oil absorbing layer then retains the oil and prevents it from penetrating deeper into the soil. A work crew is immediately dispatched to remove the failed equipment and excavate the oil

contaminated layers of ground. Provided the work crew is dispatched soon enough, the soil below the oil absorbing layer is not contaminated with oil.

Referring firstly to Figure 1, the present invention will now be described in greater detail. Temporary oil retaining system 10 comprises a subterranean layer 12 positioned below oil containing equipment 16 and directly on top of soil 18. Subterranean layer 12 is formed of oil absorbing, water permeable material layered between geotextile fabric layers 34 and 32 and below an oil permeable substrate layer 15 and overburden layer 14. Power transformer 16, or some other oil containing equipment, is mounted directly on top of overburden layer 14. Oil containing equipment 16 is mounted within a depression 9 to contain the spilled oil within the depression.

Overburden layer 14, is preferably composed of loose material such as gravel or crushed rock. Overburden layer 14 forms a protective cover for oil absorbing layer 12, preventing the oil absorbing material from being washed away during rainstorms or spring runoffs. Overburden layer 14 also acts to cool hot oil spilled from equipment 16, thereby decreasing the chances of an oil fire. The material forming overburden layer 14 must be sufficiently oil permeable to permit the spilled oil to pass directly and quickly towards substrate layer 15, thus preventing oil from pooling on or flowing off the surface of overburden layer 14. Substrate layer 15, while being oil permeable, is made of a material, such as soil or fine sand, which permits the oil to penetrate layer 15 at a relatively slow rate compared to overburden layer 14. Substrate layer 15 acts to slow the downward flow of leaked oil and also permits the air to move horizontally through

overburden layer 14 before penetrating towards oil absorbing layer 12. The horizontal travel of the spilled oil prevents the formation of funnels of spilled oil directly underneath equipment 16, thereby decreasing the chance that portions of oil absorbing layer 12 will be saturated with oil prematurely. Substrate layer 15 is made of sand, soil or some other oil permeable material finer than the material composing overburden layer 14.

The horizontal dimensions of layers 14, 12 and 15 are selected to substantially encompass the ground surface beneath oil containing equipment 16 which is likely to receive oil spilled from the equipment. Layers 14, 12 and 15 extend to banks 13 of depression 9. Oil impermeable liner 17 surrounds the circumference of layers 14, 12 and 15 along banks 13 of depression 9 to ensure that no oil percolates or leaks horizontally beyond the layers. Preferably, oil impermeable liner 17 is a commercially available liquid spray applied liner system.

The thickness of layers 14 and 15 vary depending on the conditions of the site. Typically, overburden layer 14 is approximately three inches thick for 19 mm size crushed stone. If the material forming substrate layer 15 has a low rate of oil permeability, as would be the case for clay based soils or fine sand, then the substrate layer may be approximately six inches thick. The thickness of the oil absorbing layer 12 depends on the volume of oil expected to leak and the oil absorbing characteristics of the material forming the oil absorbing layer.

The composition of oil absorbing layer 12 is important to the effectiveness of the temporary oil retaining system. The material must not only have a high oil

retention capability, but it must also have an oil absorption rate sufficiently high to absorb the spilled oil as it is deposited into the oil absorbing layer. The oil absorption rate and oil absorption capacity of the material forming oil absorbing layer 12 depends on such things as the composition of the material, its density and the type of oil being absorbed. Preferably, the material should have oil absorbing capacities of at least 2 liters of oil per kilogram of oil absorbing material. Furthermore, it is desirable that the material has hydrophobic characteristics so that it does not retain too much water, thereby preserving the material's oil absorbing characteristics when soil 18 is wet. Finally, in order to maintain the drainage characteristics of the surrounding ground, the oil absorbing material must be sufficiently water permeable to permit rain or runoff water to percolate through oil absorbing layer 12. It has been discovered that a relatively hydrophobic peat based material is an effective ingredient for oil absorbing layer 12. In particular, the material Peat Sorb™, manufactured by Peat Sorb Inc., having an oil absorbing capacity for Voltessa 35™ oil of 3.88 liters of oil per kilogram (at 23°C and a density of 0.17 g/cm^3), has proven to be effective as the oil absorbing material for use in the oil absorbing layer. Other potential oil absorbing materials are readily available in the market and would include synthetic fibres made from olefin, polyester, and the like.

To retain the oil absorbing material as a distinct layer, oil absorbing layer 12 should also comprise a retaining structure for preventing the oil absorbing material from migrating or compacting. The material retaining structure can take a variety of forms such as loose netting, open grids, webbing or a variety of

other structures having cells for containing the oil absorbing material. Alternatively, the retaining structure can take the form of a quilted sheet filled with the oil absorbing material. Further alternatives include fabric sacks filled with the oil absorbing material, or mats woven from oil absorbing fibres. It has been discovered that a honeycomb structure having substantially vertically oriented cells is particularly useful as a retaining structure. Referring to Figure 2, the preferred retaining structure is shown generally as item 11 and comprises a wide honeycomb sheet structure having a plurality of cells 24. Each cell 24 has walls 20, open top 28 and open bottom 30. Walls 20 define cavities 26, which can be filled with oil absorbing material (not shown). Walls 24 are provided with perforations 22 of sufficient diameter to permit oil to migrate from one cell to an adjacent cell. Preferably perforations 22 are approximately one cm in diameter. The dimensions of retaining structure 11 can vary, provided the cells are dimensioned to hold a sufficient quantity of oil absorbing material. It has been discovered that cells having a surface area of approximately 260 cm^2 and a height of between 75 mm to 200 mm are adequate. As seen from Figure 2, retaining structure 11 is essentially formed from a series of longitudinal strips bonded together. GEOWEB™ Cellular Confinement sheets, manufactured by Presto Products Company, has proven to be suitable for retaining structure 11. When a thicker layer of oil absorbing material is called for, sheets of retaining structures 11 filled with oil absorbing material can be placed one on top of the other until the desired thickness is achieved.

Referring now to Figure 3, oil absorbing layer 12 may further comprise bottom fabric layer 32 positioned directly on top of soil 18 and directly below retaining structure 11, and top fabric layer 34 positioned directly on top of retaining structure 11 and directly below substrate layer 15. Fabric layers 32 and 34 are water and oil permeable. Fabric layers 32 and 34 prevent the oil absorbing material from migrating or washing away.

A minimum amount of the oil absorbing material is required to absorb a known quantity of oil. Thus, depending upon the quantity of oil required to be retained as a result of an oil spill, the thickness and the surface area that the oil absorbing material would be required to cover can be designed for.

Referring to Figure 4, oil absorbing layer 12 is provided as a means of temporarily retaining oil accidentally spilled from transformer 16. Oil absorbing layer 12 is contoured to have a thicker portion 38 and a thinner portion 36. The thickness of thicker portion 38 is selected to ensure that all of the oil likely to spill from transformer 16 is retained in thicker portion 38 and that no spilled oil contacts soil 18. Thicker portion 38 is positioned where it is most likely that a heavier oil spill is to occur; in this case, directly below transformer 16. Where there is less likelihood of a heavy oil spill, oil absorbing layer 12 can be thinner; therefore, thinner portion 36 is located at a position somewhat away from transformer 16. To minimize the chance of exposing any soil 18 to leaked transformer oil, oil absorbing layer 12 should also be sufficiently wide to take into account any lateral movement of spilled oil.

To ensure the oil absorbing material retains its oil absorbing capacity, it should be as water-free as possible. The oil absorbing materials hydrophobicity minimizes the absorption of water by the material; however, to ensure the material maintains its oil absorbing properties, a means for draining water from the oil absorbing layer may be provided.

Referring to Figure 5, oil retaining system 10 may further include a water drainage system shown generally as item 40. Water drainage system 40 comprises at least one water channel 42 buried below oil absorbing layer 12 and draining into drainage basin 50. Riser 54 communicates with drainage basin 50 and permits water pump 44 to draw drain water out of the drainage basin. Excess drain water is pumped off the site through discharge pipe 56. As a safety feature, drainage system 40 may further comprise an oil sensor 48 for sensing the presence of oil in the drain water.

Water channel 42 may comprise a perforated plastic pipe of the type commonly used for underground drainage. Drainage basin 50 should be a hollow containment vessel, preferably made from an oil impermeable material. Suitable drainage basins are available in the marketplace. Riser 54 is preferably a plastic or metal pipe. Riser 54 should extend to the bottom of basin 50 to ensure that all of the drainage water contained in the basin is pumped out. Oil sensor 48 detects the presence of oil in the drain water. Oil in the drain water is one indication that equipment 16 is leaking oil. Preferably, oil sensor 48 is operably coupled to a remote monitoring site (not shown) to sound an alarm should the sensor detect oil in the drainage water. Oil sensor 48 may be placed

within basin 50 or, alternatively the sensor may be located adjacent to pump means 44.

Referring back to Figure 3, constructing the oil retaining system at a desired transformer site, is a simple matter. Firstly, a trench is dug to the desired depth. Depending on the amount of oil likely to spill, and therefore the desired thickness of oil retaining layer 12, the depth of the trench can be calculated. The trench is then lined with fabric by placing fabric sheet 32 directly on top of soil 18. Retaining structure 11 is then placed on top of fabric sheet 32 and the oil retaining material (preferably Peat Sorb™) is then shoveled directly on top of retaining structure 11. The oil retaining material is manipulated such that it fills all of cells 24 of retaining structure 11. If a thicker oil retaining layer is required, another retaining structure 11 can be placed directly on top of the lower retaining structure and the upper retaining structure is then filled with oil retaining material. Fabric 34 is then placed on top of retaining structure 11 after the retaining structure has been completely filled with the oil retaining material. Soil or fine sand is then layered over fabric 34 to form substrate layer 15. Gravel or crushed rock is then layered on top of substrate layer 15 to form overburden layer 14. As stated earlier, oil retaining system 10 is bermed around the perimeter of the containment area and an oil impermeable liner 17 is installed around the perimeter. The transformer or other oil containing equipment can then be erected directly on top of overburden layer 14.

Referring back to Figure 1, when a fault condition occurs and oil leaks out of oil containing equipment 16, it passed directly into oil overburden layer 14. If

the oil spills quickly from equipment 16, then substrate layer 14 prevents the oil from funneling directly to oil retaining layer 12. Substrate layer 14 then channels the oil directly to substrate layer 15 and oil retaining layer 12. Layer 12 absorbs the oil and prevents it from passing to soil 18. A work crew is then dispatched to remove oil containing equipment 16. Layers 14 and 15 are excavated and oil retaining layer 12 is removed. The overburden, substrate and oil absorbing materials which have been contaminated by oil can then be removed to a remote site for decontamination or disposal. It has been discovered that oil absorbing layer 12 can retain the spilled oil and prevent it from leaching into soil 18 for several hours, permitting a work crew ample time to deal with the oil leak problem.

The invention having been so described, certain modifications and adaptations will be obvious to those skilled in the art. The invention includes all such modifications and adaptations which follow in the scope of the appended claims.

THEREFORE WHAT IS CLAIMED IS

1. A system for containing oil spilled from oil containing equipment comprising a subterranean oil absorbing layer positioned substantially below the oil containing equipment, said layer formed from an oil absorbing material.

2. A system as defined in claim 1 wherein the subterranean layer is water permeable.

3. A system as defined in claim 2 wherein the oil absorbing material has hydrophobic properties.

4. A system as defined in claim 3 wherein the subterranean layer further comprises a retaining structure for physically containing the oil absorbing material within the subterranean layer.

5. A system as defined in claim 4 wherein the retaining structure has a plurality of cells for containing the oil absorbing material.

6. A system as defined in claim 5 wherein the retaining structure comprises a honeycomb of cells, each cell having substantially vertical walls, a cavity, an open top and an open bottom, the cavity configured to retain the oil absorbing material.

7. A system as defined in claim 6 wherein the substantially vertical walls are provided with perforations dimensioned to permit oil to pass from one cell cavity to an adjacent cell cavity.

8. A system as defined in claim 6 or 7 wherein the subterranean layer further comprises top and bottom fabric layers positioned immediately above and immediately below the honeycomb, the fabric layers being oil and water permeable.

9. A system as defined in claim 2 further comprising a layer of oil permeable substrate material positioned immediately above the subterranean layer, the equipment being mounted on top of the oil permeable overburden layer.

10. A system as defined in claim 9 further comprising a layer of oil permeable substrate material positioned above the subterranean layer and below the overburden layer, the substrate layer having a slower rate of oil permeability than the overburden layer.

11. A system defined in claim 8 wherein the overburden material is selected from the group consisting of gravel and crushed rock.

12, A system as defined in claim 9 wherein the substrate material is selected from the group consisting of fine sand and soil.

13. A system as defined in claim 3 wherein the oil absorbing material is a peat based material.

14. A system as defined in claim 1 further comprising a drainage means for draining water from the oil absorbing layer.

15. A system as defined in claim 14 wherein the drainage means comprises at least one water channel buried below the oil absorbing layer for capturing drainage water, the channel emptying into a basin, the basin being drained by a pumping means.

16. A system as defined in claim 15 further comprising an oil sensor for sensing the presence of oil in the drainage water.

17. A liner system around the perimeter of the subterranean layer to prevent the air from escaping the oil absorbing layer.

18. An air absorbing material for use in constructing an air containing system comprising a subterranean layer of said material.

19. A material as defined in claim 18 wherein the material is water permeable.

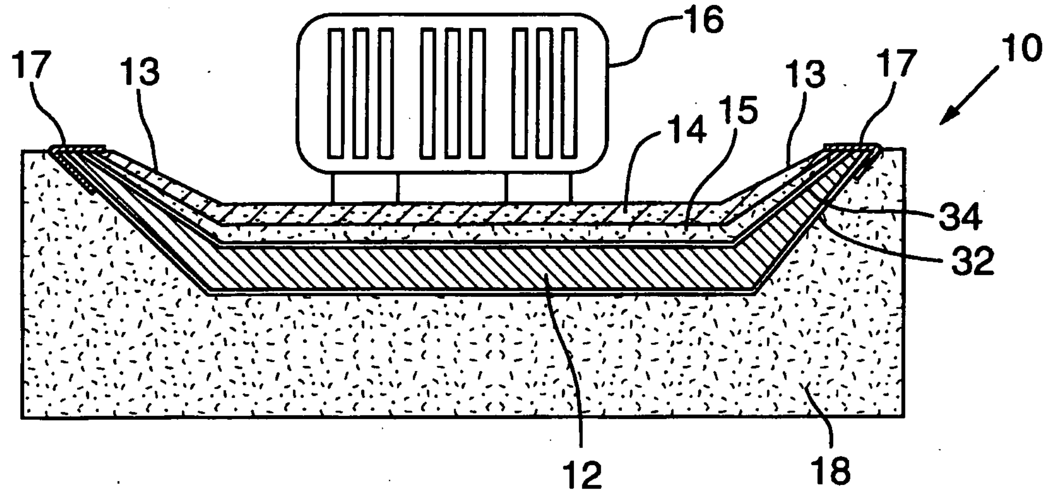


FIG.1

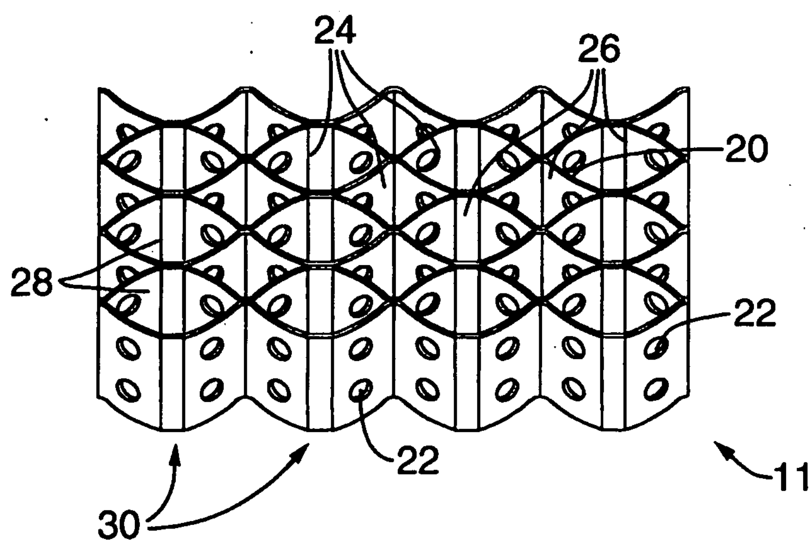


FIG.2

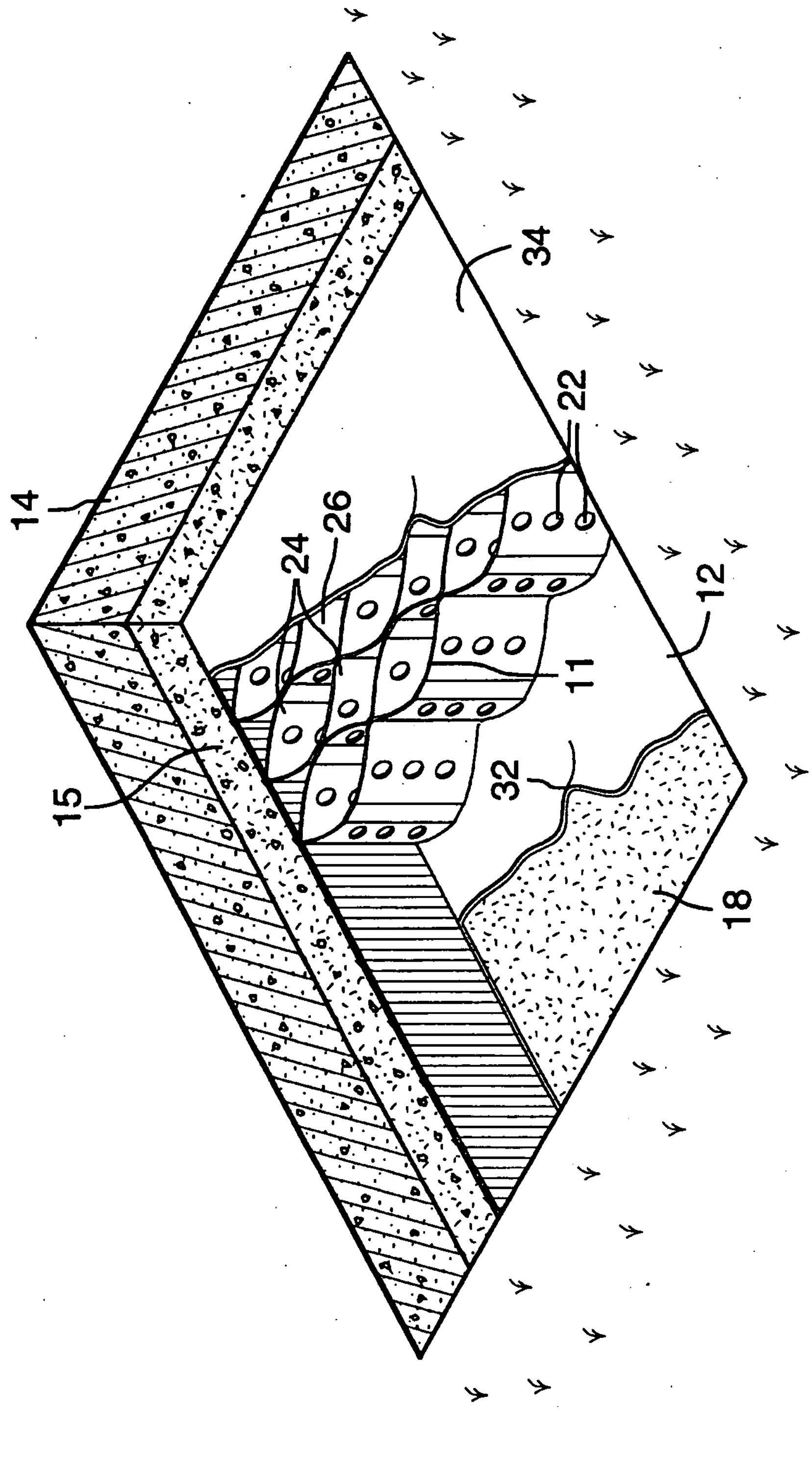


FIG.3

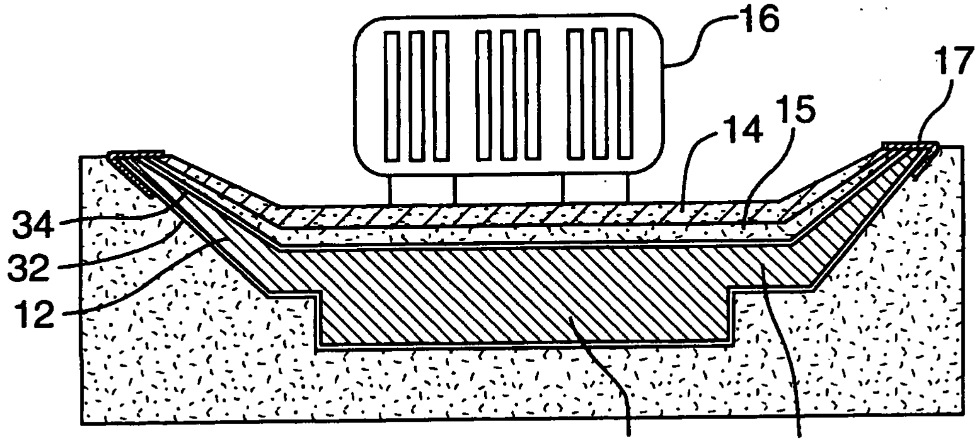

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FIG.4

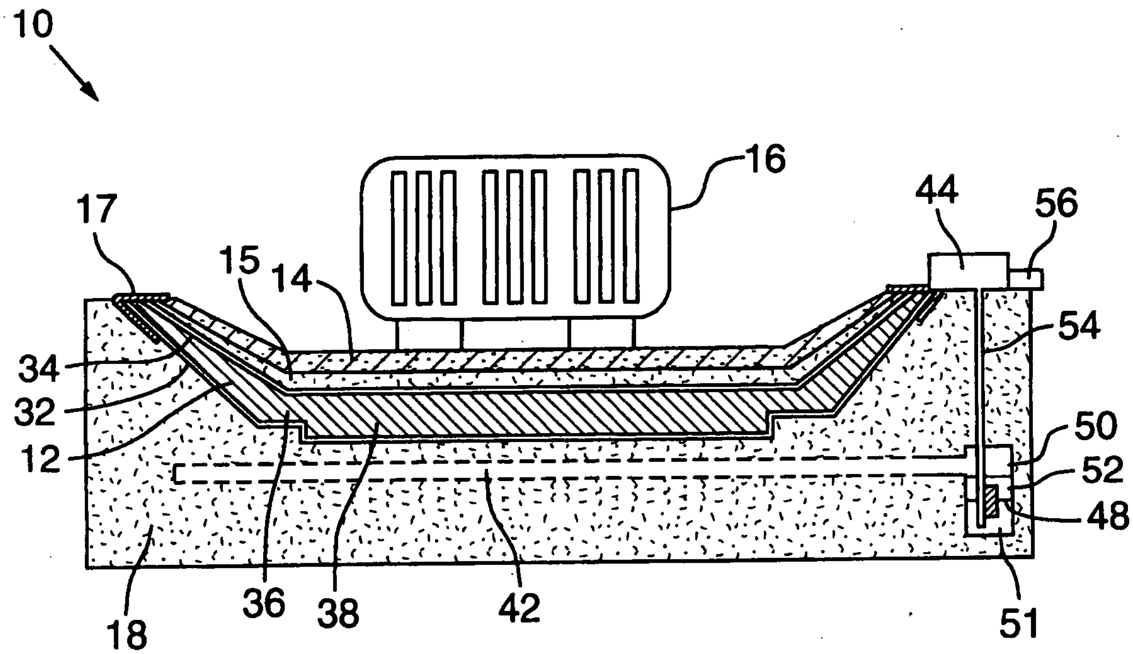
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FIG.5